tuberous sclerosis complex

Tuberous sclerosis complex is a genetic disorder characterized by the growth of numerous noncancerous (benign) tumors in many parts of the body. These tumors can occur in the skin, brain, kidneys, and other organs, in some cases leading to significant health problems. Tuberous sclerosis complex also causes developmental problems, and the signs and symptoms of the condition vary from person to person.

Virtually all affected people have skin abnormalities, including patches of unusually light-colored skin, areas of raised and thickened skin, and growths under the nails. Tumors on the face called facial angiofibromas are also common beginning in childhood.

Tuberous sclerosis complex often affects the brain, causing seizures, behavioral problems such as hyperactivity and aggression, and intellectual disability or learning problems. Some affected children have the characteristic features of autism, a developmental disorder that affects communication and social interaction. Benign brain tumors can also develop in people with tuberous sclerosis complex; these tumors can cause serious or life-threatening complications.

Kidney tumors are common in people with tuberous sclerosis complex; these growths can cause severe problems with kidney function and may be life-threatening in some cases. Additionally, tumors can develop in the heart, lungs, and the light-sensitive tissue at the back of the eye (the retina).

Frequency

Tuberous sclerosis complex affects about 1 in 6,000 people.

Genetic Changes

Mutations in the *TSC1* or *TSC2* gene can cause tuberous sclerosis complex. The *TSC1* and *TSC2* genes provide instructions for making the proteins hamartin and tuberin, respectively. Within cells, these two proteins likely work together to help regulate cell growth and size. The proteins act as tumor suppressors, which normally prevent cells from growing and dividing too fast or in an uncontrolled way.

People with tuberous sclerosis complex are born with one mutated copy of the *TSC1* or *TSC2* gene in each cell. This mutation prevents the cell from making functional hamartin or tuberin from the altered copy of the gene. However, enough protein is usually produced from the other, normal copy of the gene to regulate cell growth effectively. For some types of tumors to develop, a second mutation involving the other copy of the *TSC1* or *TSC2* gene must occur in certain cells during a person's lifetime.

When both copies of the *TSC1* gene are mutated in a particular cell, that cell cannot produce any functional hamartin; cells with two altered copies of the *TSC2* gene are unable to produce any functional tuberin. The loss of these proteins allows the cell to grow and divide in an uncontrolled way to form a tumor. In people with tuberous sclerosis complex, a second *TSC1* or *TSC2* mutation typically occurs in multiple cells over an affected person's lifetime. The loss of hamartin or tuberin in different types of cells leads to the growth of tumors in many different organs and tissues.

Inheritance Pattern

Tuberous sclerosis complex has an autosomal dominant pattern of inheritance, which means one copy of the altered gene in each cell is sufficient to increase the risk of developing tumors and other problems with development. In about one-third of cases, an affected person inherits an altered *TSC1* or *TSC2* gene from a parent who has the disorder. The remaining two-thirds of people with tuberous sclerosis complex are born with new mutations in the *TSC1* or *TSC2* gene. These cases, which are described as sporadic, occur in people with no history of tuberous sclerosis complex in their family. *TSC1* mutations appear to be more common in familial cases of tuberous sclerosis complex, while mutations in the *TSC2* gene occur more frequently in sporadic cases.

Other Names for This Condition

- Bourneville disease
- Bourneville phakomatosis
- cerebral sclerosis
- epiloia
- sclerosis tuberosa
- tuberose sclerosis

Diagnosis & Management

These resources address the diagnosis or management of tuberous sclerosis complex:

- GeneReview: Tuberous Sclerosis Complex
  https://www.ncbi.nlm.nih.gov/books/NBK1220
- Genetic Testing Registry: Tuberous sclerosis syndrome
  https://www.ncbi.nlm.nih.gov/gtr/conditions/C0041341/
- MedlinePlus Encyclopedia: Tuberous Sclerosis
  https://medlineplus.gov/ency/article/000787.htm
- Tuberous Sclerosis Alliance: TSC Clinics
  http://www.tsalliance.org/individuals-families/tsc-clinics/

These resources from MedlinePlus offer information about the diagnosis and management of various health conditions:

- Diagnostic Tests
  https://medlineplus.gov/diagnostictests.html
- Drug Therapy
  https://medlineplus.gov/drugtherapy.html
- Surgery and Rehabilitation
  https://medlineplus.gov/surgeryandrehabilitation.html
- Genetic Counseling
  https://medlineplus.gov/geneticcounseling.html
- Palliative Care
  https://medlineplus.gov/palliativecare.html

Additional Information & Resources

MedlinePlus

- Encyclopedia: Tuberous Sclerosis
  https://medlineplus.gov/ency/article/000787.htm
- Health Topic: Tuberous Sclerosis
  https://medlineplus.gov/tuberoussclerosis.html

Genetic and Rare Diseases Information Center

- Tuberous sclerosis
  https://rarediseases.info.nih.gov/diseases/7830/tuberous-sclerosis

Additional NIH Resources

- National Institute of Neurological Disorders and Stroke
  https://www.ninds.nih.gov/Disorders/All-Disorders/Tuberous-sclerosis-Information-Page

Educational Resources

- Boston Children's Hospital
  http://www.childrenshospital.org/conditions-and-treatments/conditions/tuberous-sclerosis-tsc
- Disease InfoSearch: Tuberous sclerosis, type 1
  http://www.diseaseinfosearch.org/Tuberous+sclerosis%2C+type+1/7256
- Disease InfoSearch: Tuberous sclerosis, type 2
  http://www.diseaseinfosearch.org/Tuberous+sclerosis%2C+type+2/7257

- Genetics Education Materials for School Success (GEMSS)
  http://www.gemssforschools.org/conditions/tuberous_sclerosis/default
- Massachusetts General Hospital
  http://www.massgeneral.org/tsc/patient-ed/tsc-body.aspx
- Merck Manual Consumer Version
  http://www.merckmanuals.com/home/children-s-health-issues/neurologic-disorders-in-children/tuberous-sclerosis
- My46 Trait Profile
  https://www.my46.org/trait-document?trait=Tuberous%20Sclerosis%20Complex&type=profile
- Orphanet: Tuberous sclerosis complex
  http://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=805

Patient Support and Advocacy Resources

- National Organization for Rare Disorders (NORD)
  https://rarediseases.org/rare-diseases/tuberous-sclerosis/
- Resource List from the University of Kansas Medical Center
  http://www.kumc.edu/gec/support/tuberous.html
- The Tuberous Sclerosis Association (UK)
  http://www.tuberous-sclerosis.org/
- Tuberous Sclerosis Alliance
  http://www.tsalliance.org

GeneReviews

- Tuberous Sclerosis Complex
  https://www.ncbi.nlm.nih.gov/books/NBK1220

Genetic Testing Registry

- Tuberous sclerosis 1
  https://www.ncbi.nlm.nih.gov/gtr/conditions/C1854465/
- Tuberous sclerosis 2
  https://www.ncbi.nlm.nih.gov/gtr/conditions/C1860707/
- Tuberous sclerosis syndrome
  https://www.ncbi.nlm.nih.gov/gtr/conditions/C0041341/

ClinicalTrials.gov

- ClinicalTrials.gov
  https://clinicaltrials.gov/ct2/results?cond=%22tuberous+sclerosis%22

Scientific articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28Tuberous+Sclerosis%5BMAJR%5D%29+AND+%28tuberous+sclerosis%5BTI%5D%29+AND+review%5Bpt%5D+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1800+days%22%5Bdp%5D

OMIM

- TUBEROUS SCLEROSIS 1
  http://omim.org/entry/191100

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